

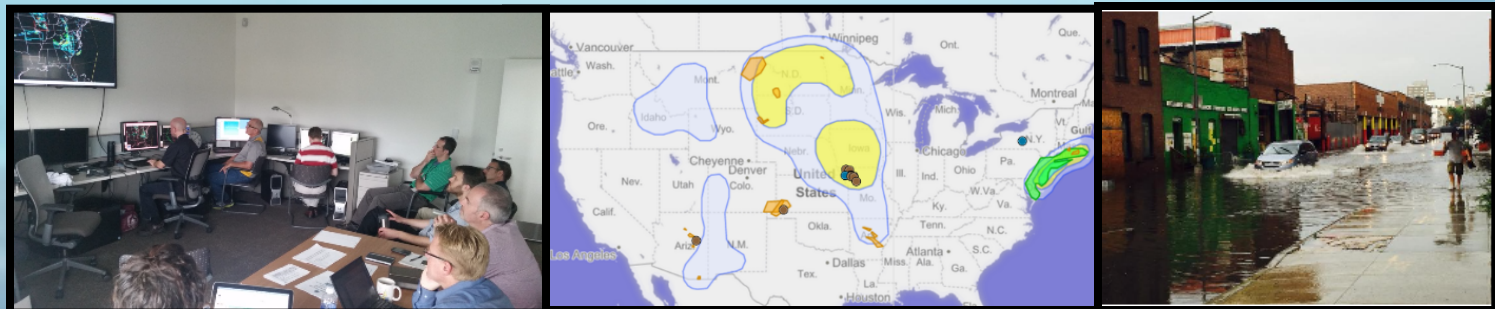
The Experimental Neighborhood Probabilistic Excessive Rainfall Outlook as Gleaned from the 2014 and 2015 Flash Flood and Intense Rainfall (FFaIR) Experiments

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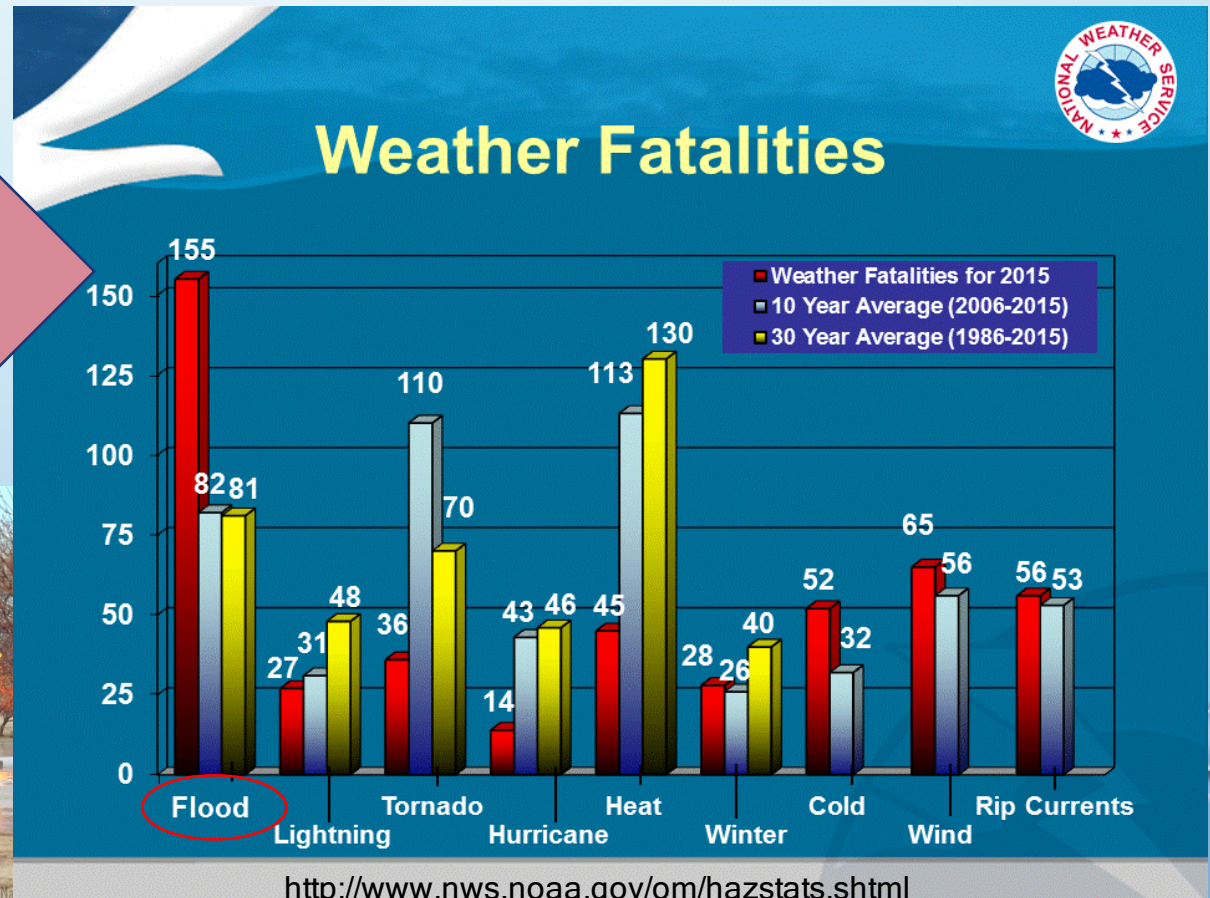
³*NOAA National Weather Service Weather Prediction Center, College Park, MD*



FLASH FLOOD EXPERIMENTATION: WHY DO WE DO THIS?

“In 2015, flash and river floods claimed 155 lives, up dramatically from 38 in 2014. The 2015 flood casualty total is well above the 10-year average of 82 deaths.”

Flooding remains the #1
life-threatening hazard



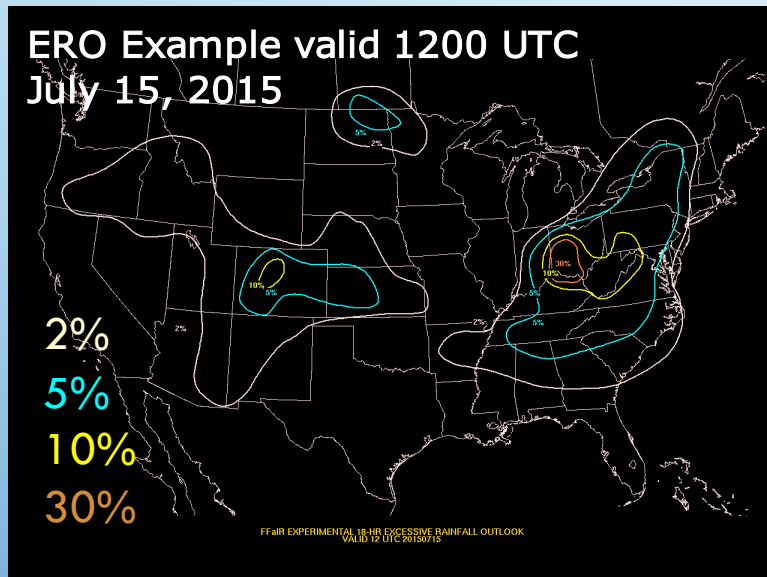
2015 FFAIR EXPERIMENT: OBJECTIVES

- Bring together participants from WFOs, the modeling community, academia, and private sector from July 6 to July 24, 2015
- Evaluate the utility of high resolution convection-allowing models (CAMs) and ensembles for short-term flash flood forecasts
- Explore proposed changes to WPC's operational Excessive Rainfall Outlook (ERO) by evaluating the utility of probabilistic flash flood forecasts for Day 1
- Explore the utility of probabilistic flash flood forecasts at different forecast lead times to support WPC's Met Watch Desk responsibilities
- Enhance cross-testbed collaboration as well as collaboration between the operational forecasting, research, and academic communities on the forecast challenges associated with short-term flash flood forecasting



2015 FFAIR EXPERIMENT: FORECAST ACTIVITIES

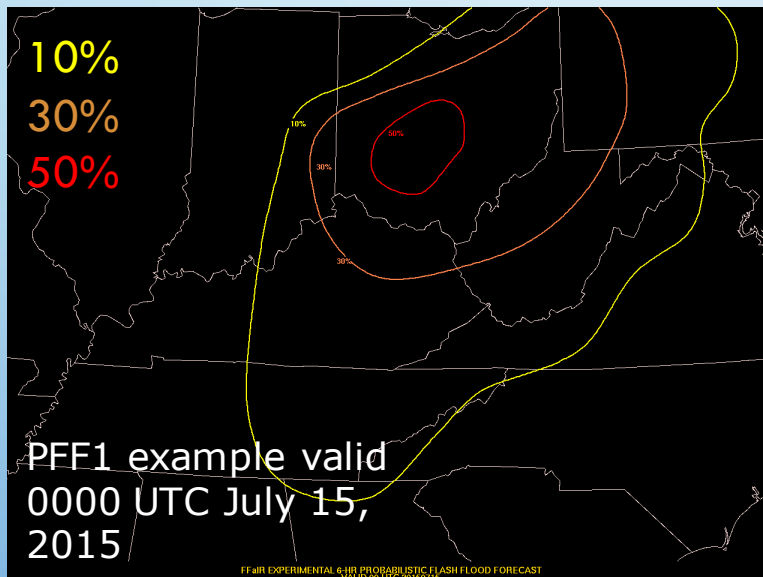
- Experimental Excessive Rainfall Outlook (ERO)
 - Issued at 1400 UTC
 - Valid 1500 – 1200 UTC (Day 1)
 - Forecast contours of 2%, 5%, 10%, and 30% probability of flash flooding within 40 km of a point the CONUS
 - 5% contour NEW for 2015 experiment



Searching under debris of mobile home after deadly flooding in Flat Gap, KY, Wednesday, July 15, 2015
AP Photo/David Stephenson

2015 FFAIR EXPERIMENT: FORECAST ACTIVITIES

- 6-hour Probability of Flash Flooding (PFF1 and PFF2)
 - Issued at 1800 UTC and 2000 UTC
 - Valid 1800-0000 UTC and 0000-0600 UTC respectively
 - Forecast contours of 10%, 30%, and 50% probability of flash flooding occurring within 40 km of a point over a chosen area of interest

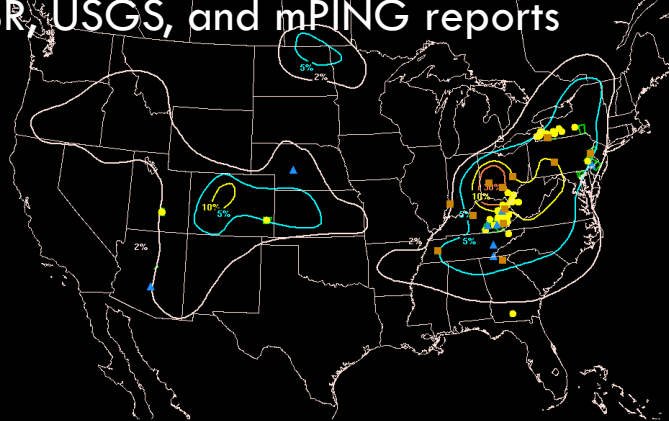


July 15, 2015:

At least six people still missing in Kentucky after violent flooding. Two people have died from the rushing water. Indiana and Illinois are also dealing with severe weather.

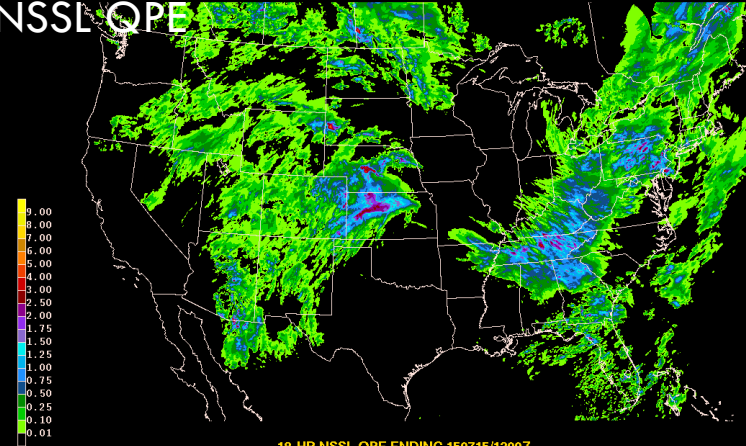
2015 FFAIR EXPERIMENT: FORECAST EVALUATION

LSR, USGS, and mPING reports



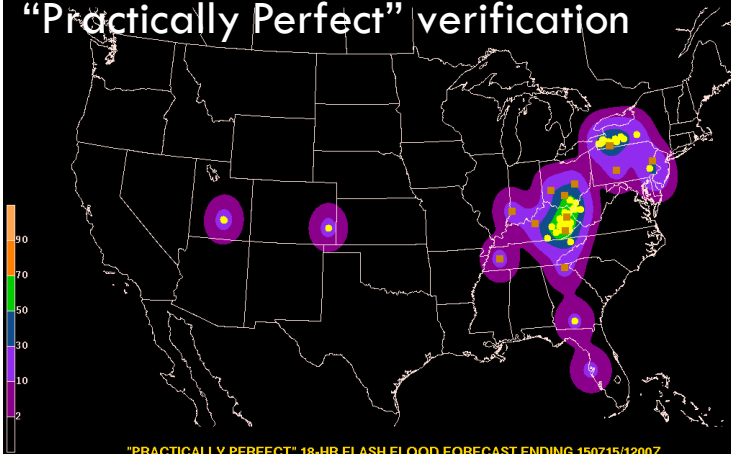
FFAIR EXCESSIVE RAINFALL OUTLOOK VALID 150714/1800Z - 150715/1200Z
YELLOW=FLASH FLOOD LSR, BLUE=FLOOD LSR, BROWN=MPING, PINK=USGS

NSSL QPE



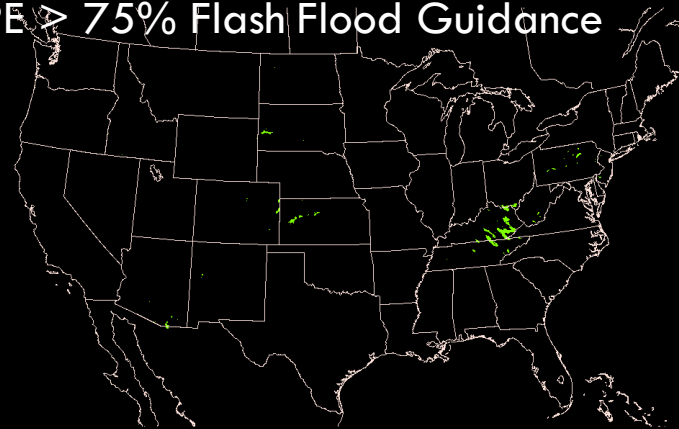
18-HR NSSL QPE ENDING 150715/1200Z

“Practically Perfect” verification



“PRACTICALLY PERFECT” 18-HR FLASH FLOOD FORECAST ENDING 150715/1200Z

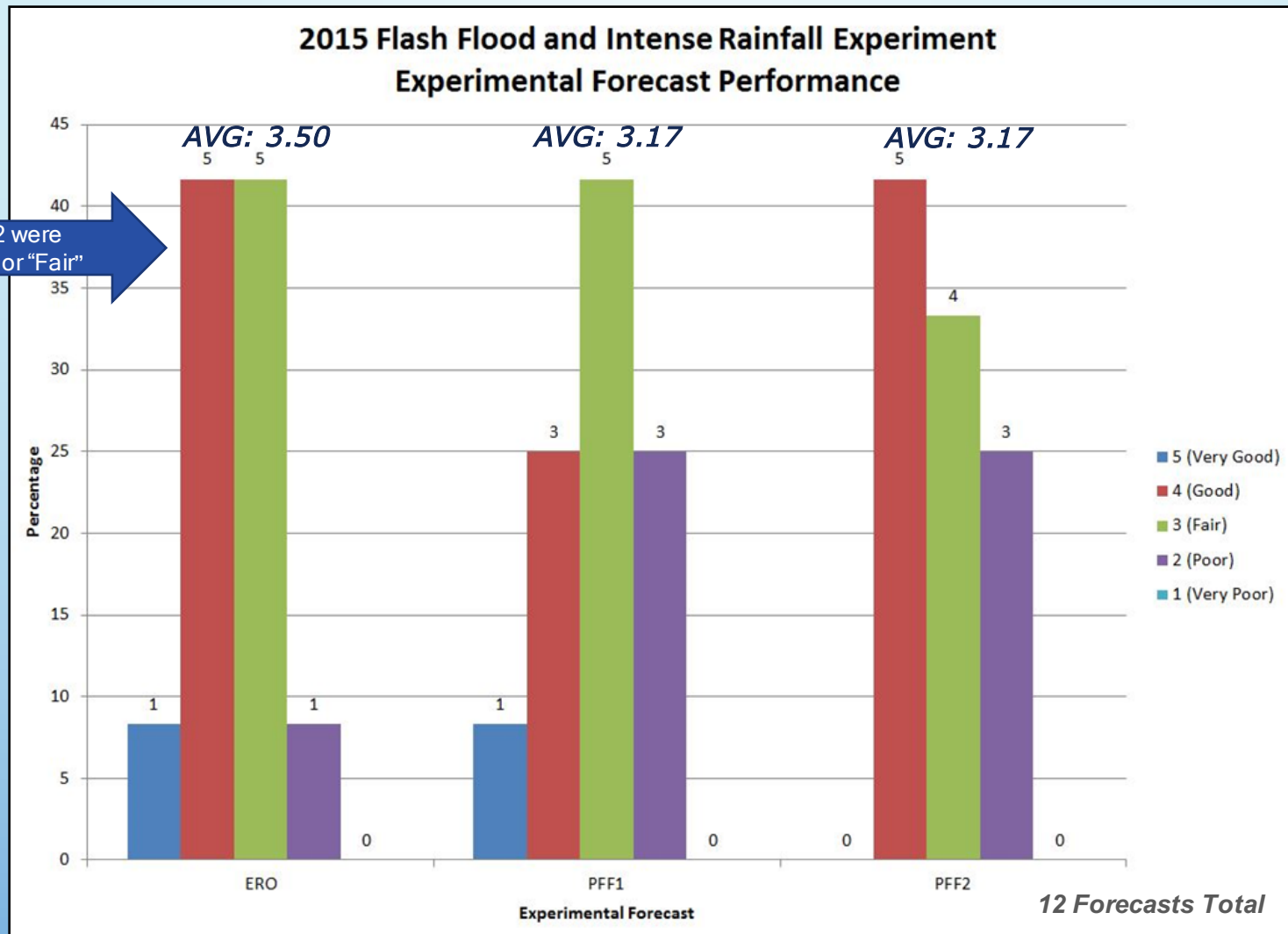
QPE ≥ 75% Flash Flood Guidance



CUMULATIVE QPE ≥ 75% FFG VALID 150714/1800Z - 150715/1200Z

Participants subjectively ranked the forecasts on a 1-5 scale (very poor, poor, fair, good, very good)

2015 FFAIR EXPERIMENT: FORECAST EVALUATION

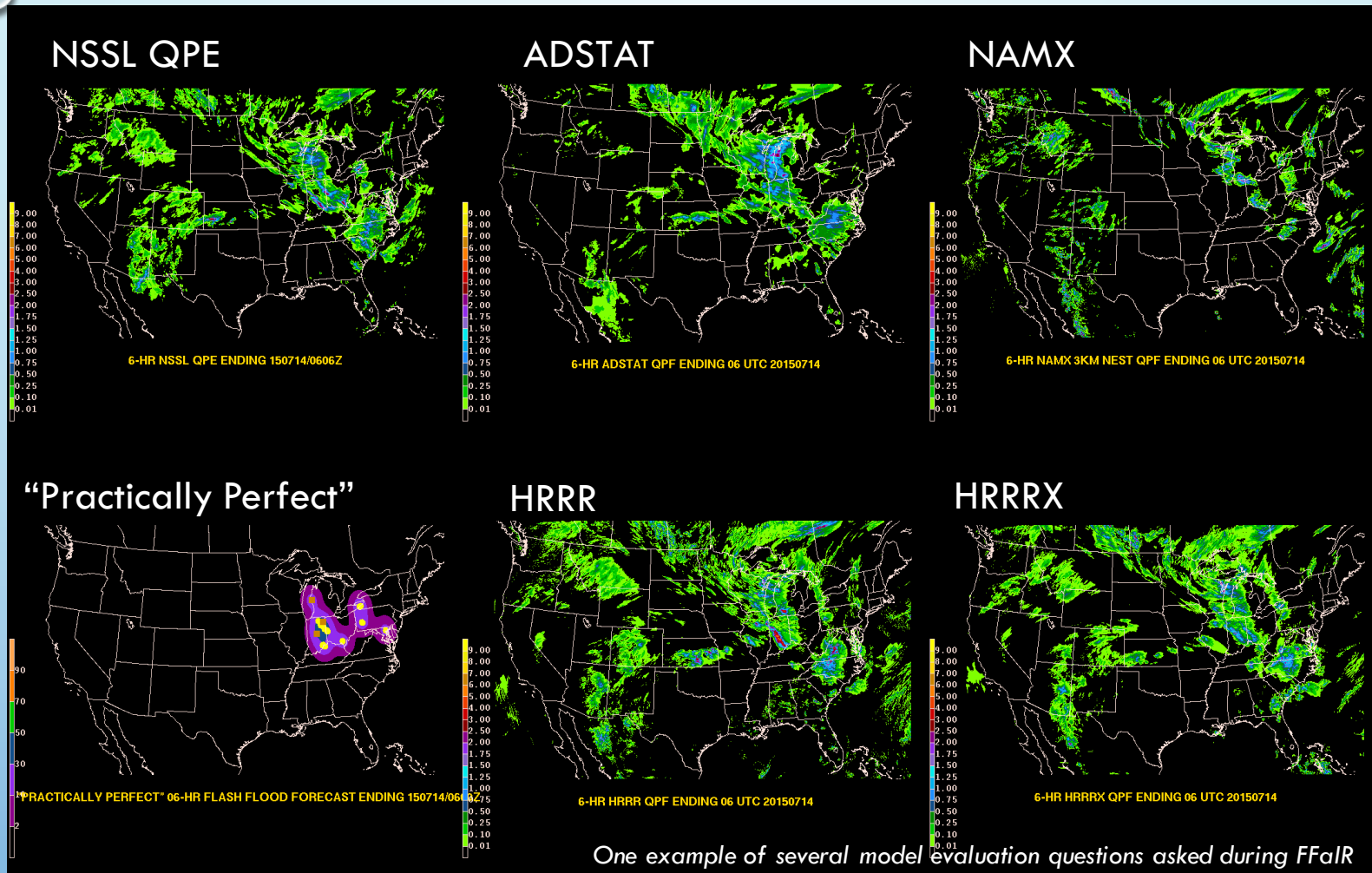


2015 FFAIR EXPERIMENT: FEATURED MODELS

Objective: Improved warm-season model QPF guidance. Improvement to convection-allowing models, including the establishment of an operational storm scale ensemble, is needed. Experimental models and ensembles were offered to the participants as forecast guidance and for subjective evaluation.

Provider	Model	Resolution	Forecast Hours
EMC	NAMX	3 km nest	60
ESRL/GSD	HRRRX	3 km	24
EMC	HREF (11 members)	5 km	36
SPC/ESRL/WPC	SSEO (7 members)	4 km	24
NWC	ADSTAT	4 km	6
NSSL/HDSC/NERF C/CSU	Precip Recurrence Data (Atlas 14)	5 km	3 and 6 hr at 1, 2, 5, 10, 25, and 100 year intervals

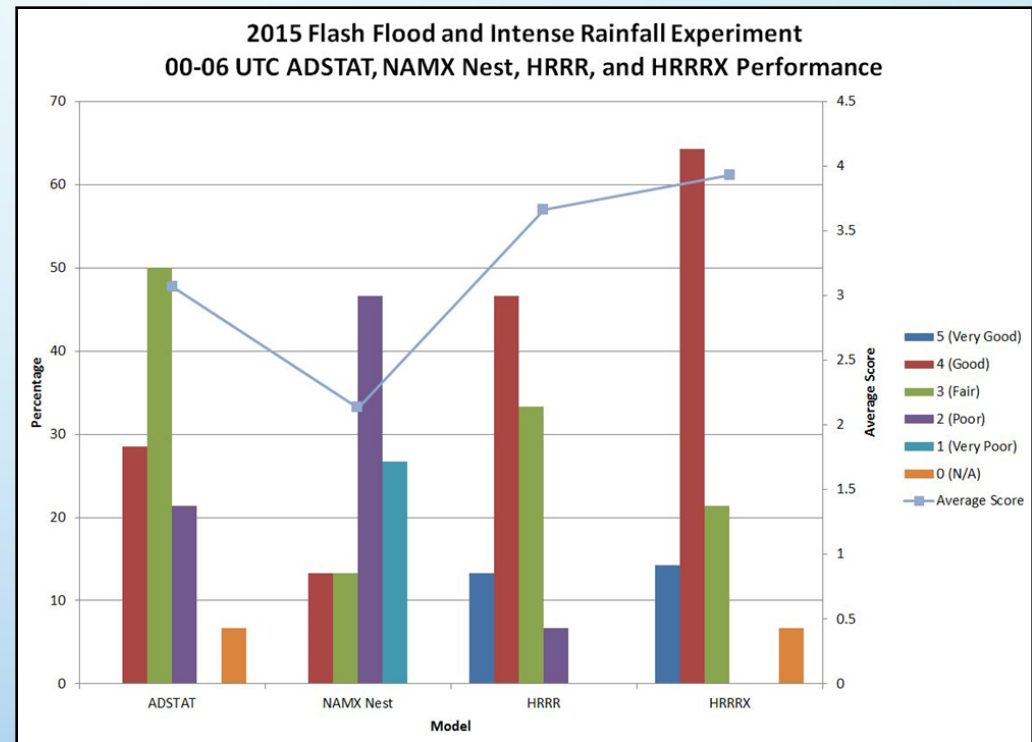
2015 FFAIR EXPERIMENT: MODEL EVALUATION



Participants subjectively ranked the models on a 1-5 scale (very poor, poor, fair, good, very good)

2015 FFAIR EXPERIMENT: DETERMINISTIC MODEL SUBJECTIVE EVALUATION

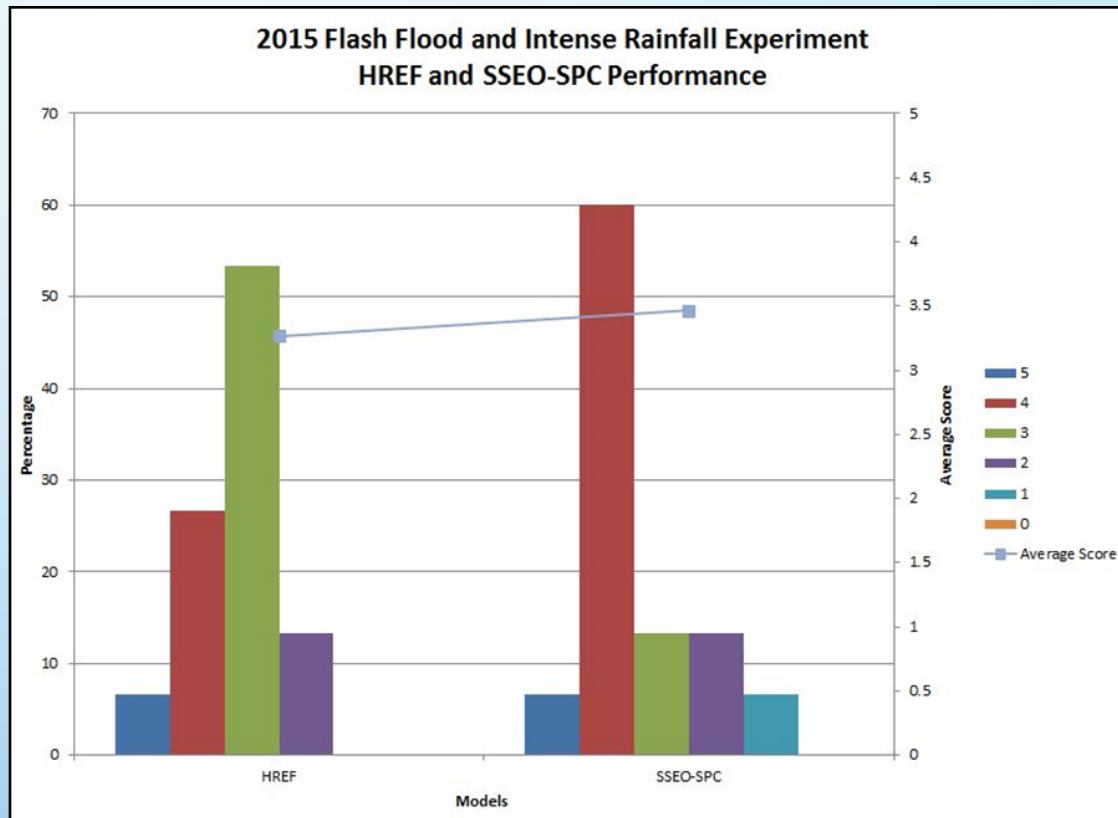
- HRRRX was rated highest with 3.93 out of 5
- HRRRX improvements noted in location and intensity over operational HRRR
- NAMX performed poorly in 00-06 UTC timeframe possibly attributed to convective spin up issues
- ADSTAT had frequent high biases with QPF max's and underperformed in Western regions where radar coverage was sparse



Bars represent the percentage that each score was assigned to each model over the three weeks. Example: 50% of ADSTAT's scores were 3's. Line represents average of all scores over three weeks.

2015 FFAIR EXPERIMENT: ENSEMBLE MODEL SUBJECTIVE EVALUATION

- SPC-SSEO mean QPF was rated slightly higher (3.45 out of 5) than the HREF (3.27 out of 5)
- HREF compared favorably with SSEO in terms of location, but was often lighter with QPF amounts
- Although membership is similar, the HREF has 11 members (8 lagged) and 5 km grid spacing vs the 4-km, 7-member SSEO

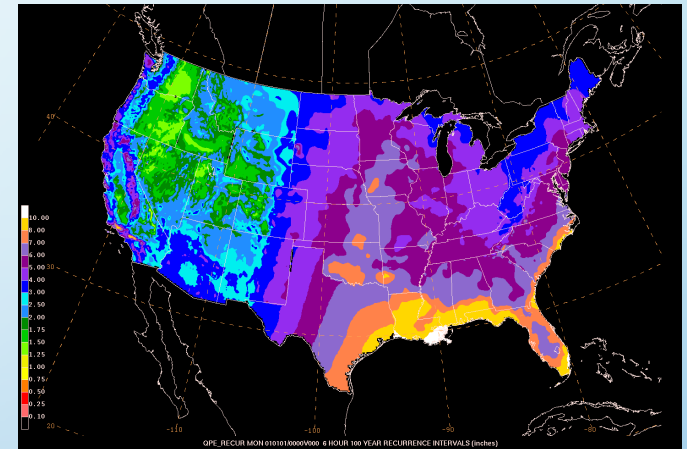


2015 FFAIR EXPERIMENT TOOL: INTRODUCING RECURRENCE INTERVALS

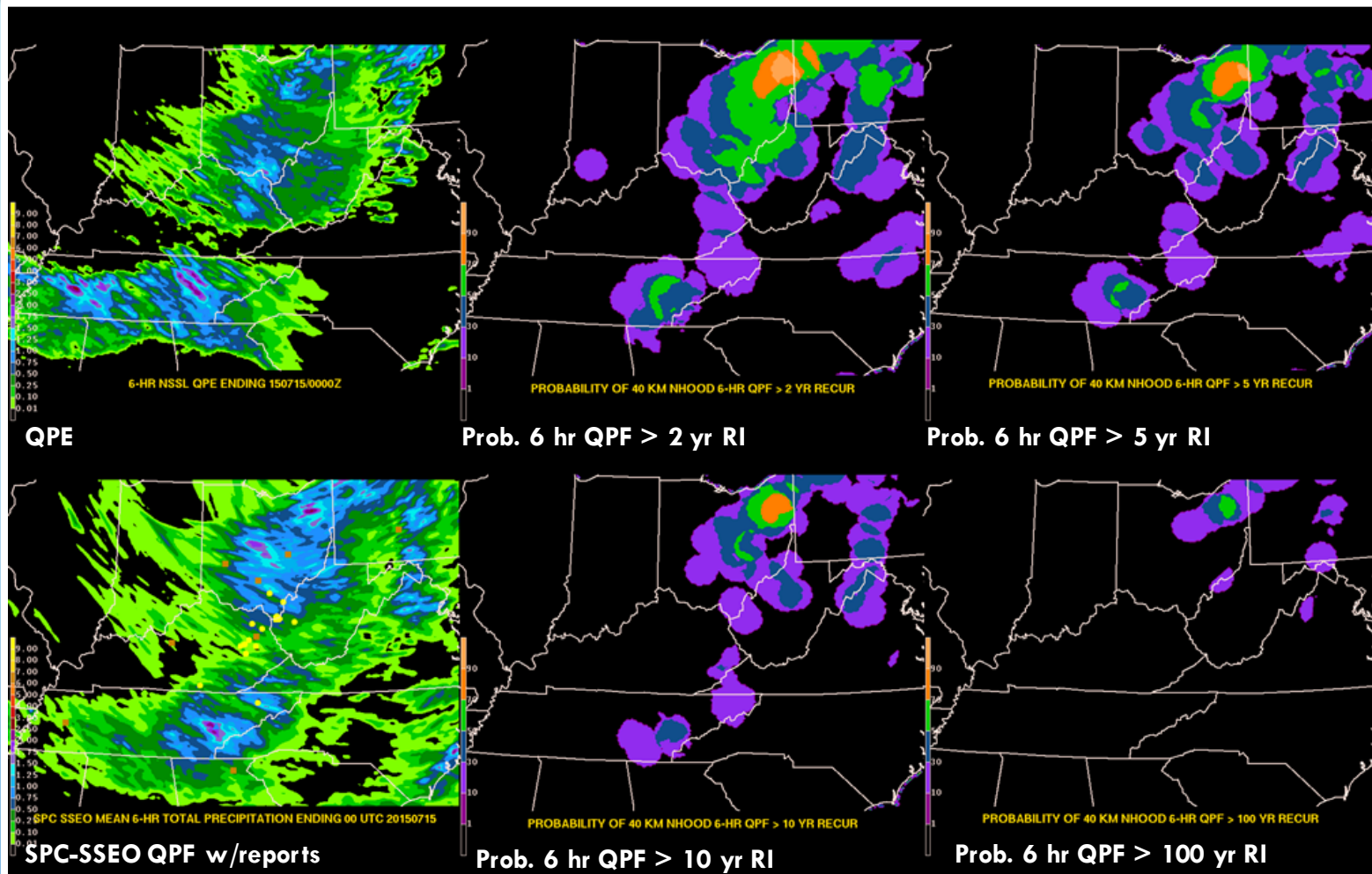
Objective: Improved flash flood forecast tools by combining meteorological and hydrologic data.

- Precipitation Frequency Estimates Produced by NOAA Atlas-14 Climatology of USGS rain gages for Recurrence Intervals from 1 to 1000 years
 - Expected frequency or estimated likelihood of excessive precipitation events based upon a 90% confidence interval
 - Indicator of where heavy rainfall may lead to flash flooding
 - Statistical probability based on historical data of rainfall and stream gages
 - Precipitation Frequency Estimates (inches) for durations of 30 minutes up to 24 hours.

Updated Atlas-14 data over Texas and Pacific NW still pending; does not account for antecedent conditions



2015 FFAIR EXPERIMENT TOOL: SSEO MODEL EXCEEDING RECURRENCE INTERVALS

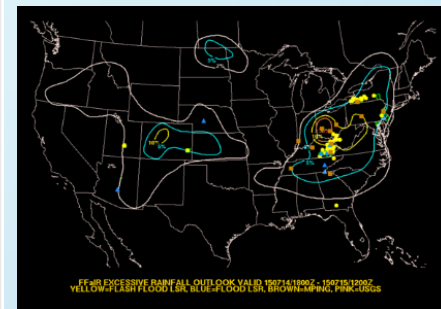
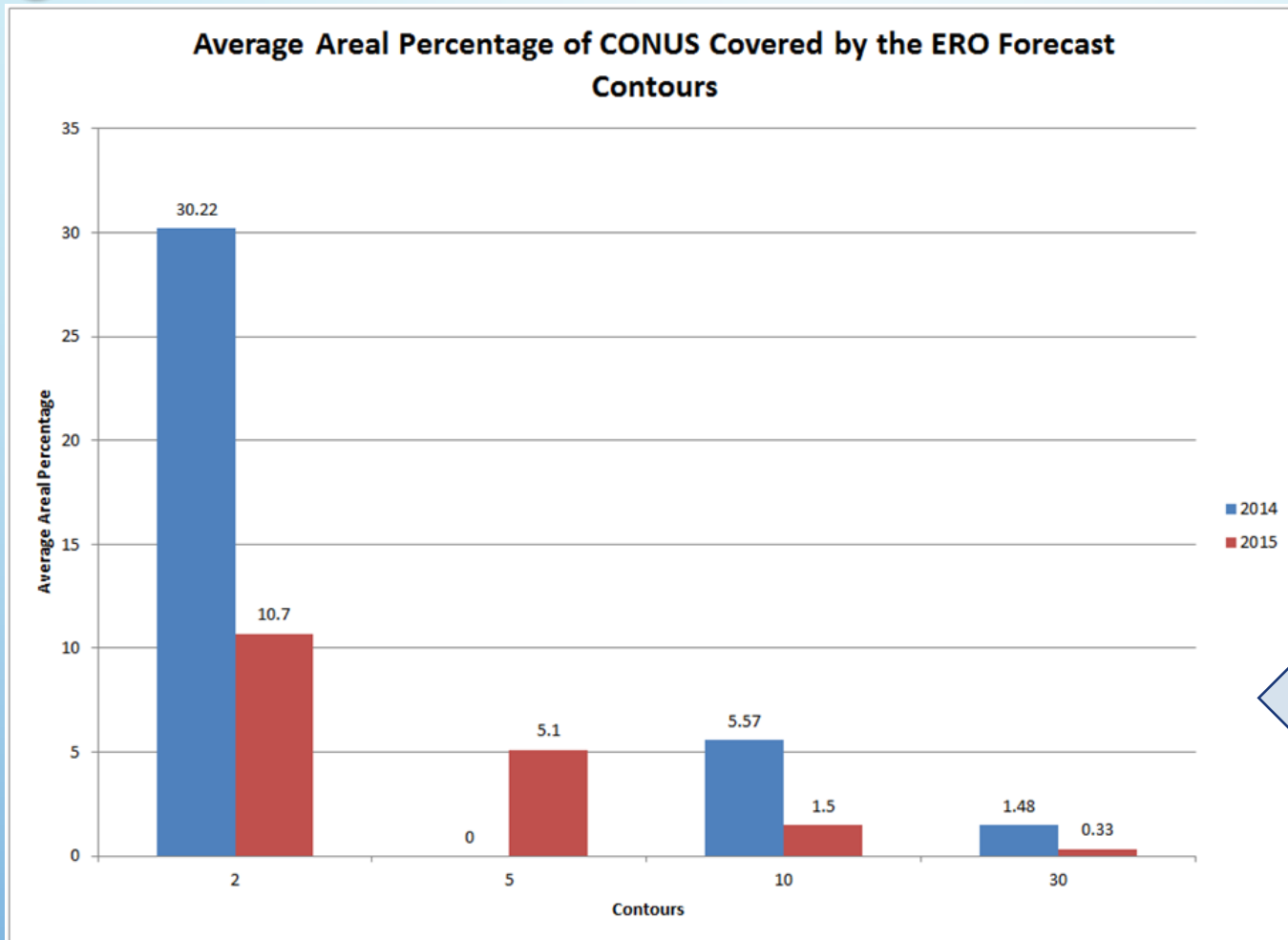


Participants subjectively ranked the RIs on a 1-5 scale (very poor, poor, fair, good, very good)

2015 FFAIR EXPERIMENT: SSEO EXCEEDING RI'S SUBJECTIVE EVALUATION

- Recurrence interval (RI) exceedances available to participants are calculated from the WPC version of the SSEO model QPF.
- Results were highly subjective and very dependent on SSEO QPF performance.
- Over the experiment, the 2 year RI was found to be most useful for raising awareness of a potential for shorter term flash flooding based on the cases shown and subjective evaluation.
- Although the 100 year RI scored the lowest in terms of value, participants noted that no signal still provided information that the event may not be extreme.
- Participants saw the value of RIs in the forecast process and desire more training of applications and exceedance tools.
- Forecasters view RIs as an addition to the flood forecast tool box to compliment other guidance, but not a replacement.

FFAIR EXPERIMENT: TESTING RESULTED IN IMPROVEMENT FROM 2014 TO 2015

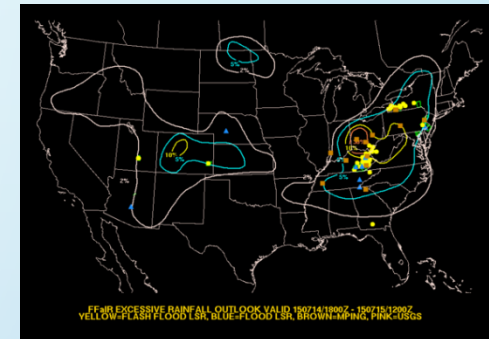
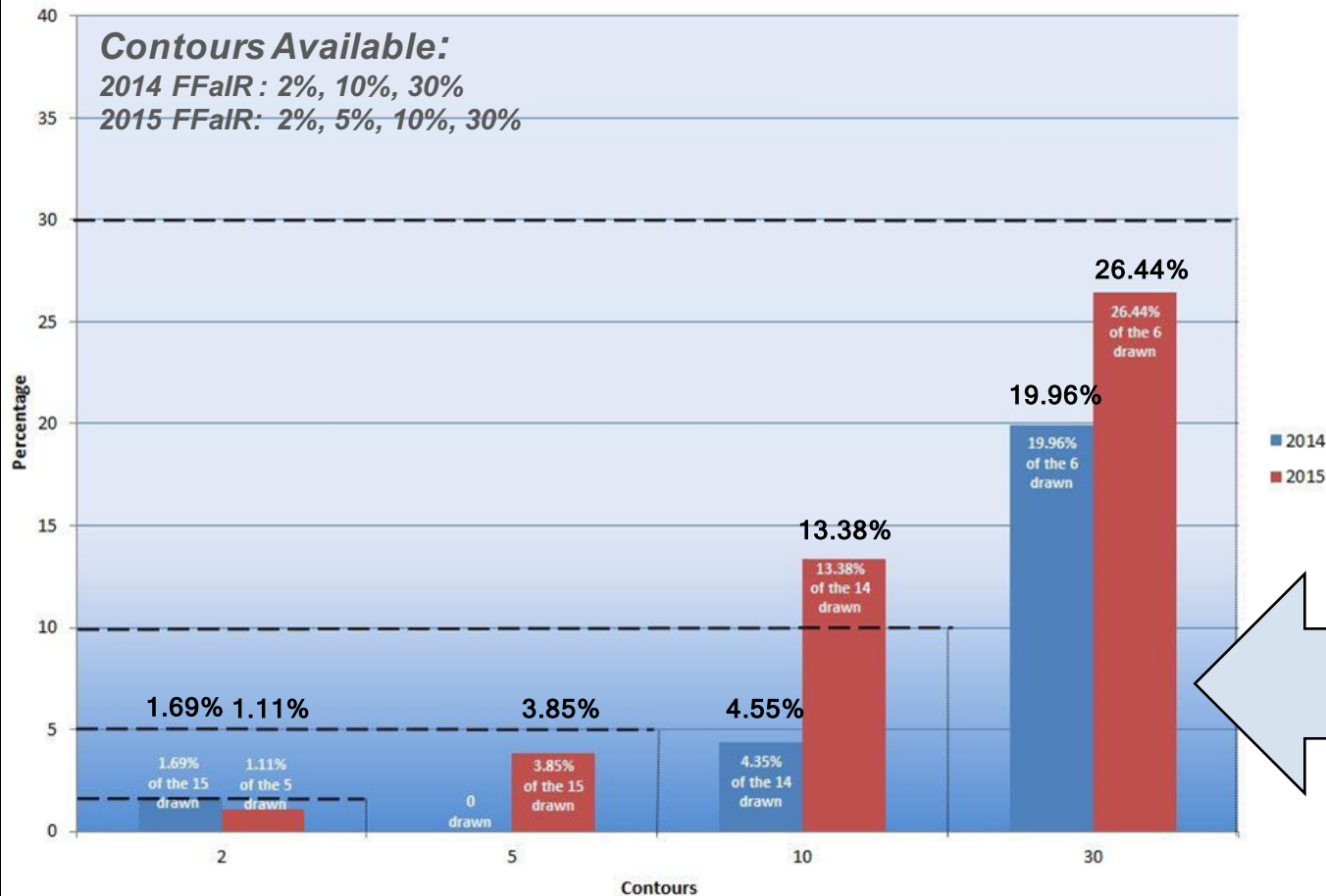


Dramatic reduction in area included in the drawn forecast contours from 2014 to 2015 due to higher model QPF confidence and addition of 5% contour

The 2015 experiment demonstrated that forecasters could skillfully forecast the probabilistic contours in the new ERO over reasonable areas of the CONUS

FFAIR EXPERIMENT: TESTING RESULTED IN IMPROVEMENT FROM 2014 TO 2015

Average Percent of Area Within 40 km of a Report for the ERO Contours



2014 :
 2% contour error= .31%
 10% contour error= 5.65%
 30% contour error= 10.04%

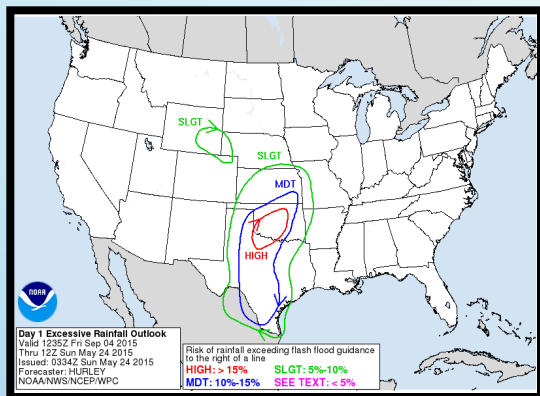
2015:
 2% contour error= .89%
 5% contour error= 1.15%
 10% contour error= 3.38%
 30% contour error= 3.56%

Perfect calibration is the average percent value of the contour areas within 40 km of the report being equal to the value of the probability contour

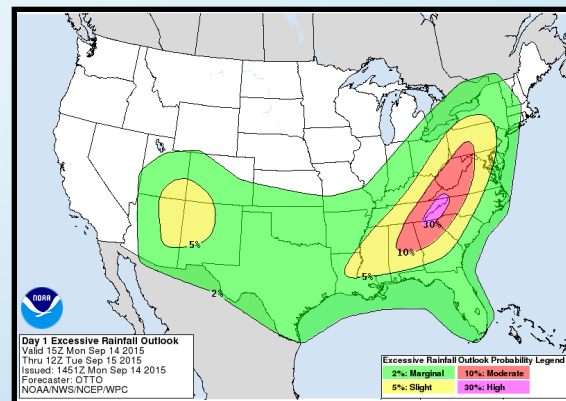
THE FUTURE ERO

A RESULT OF FFAIR EXPERIMENT TESTING AND OPERATIONAL FORECASTER ASSESSMENTS

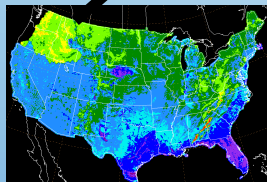
NOW



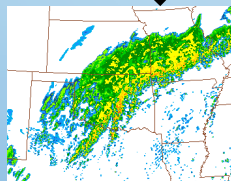
2018



Human Synthesis

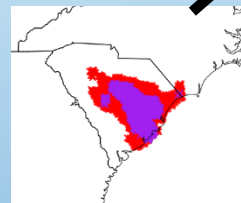


FFG

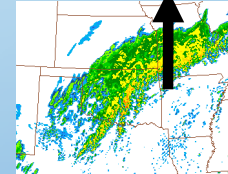


Model
Rainfall

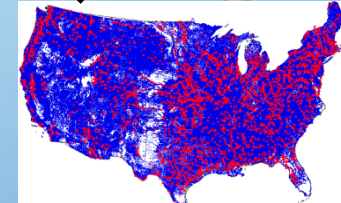
Human Synthesis



FFG + Climate
Resources



Model
Rainfall



National
Water Model

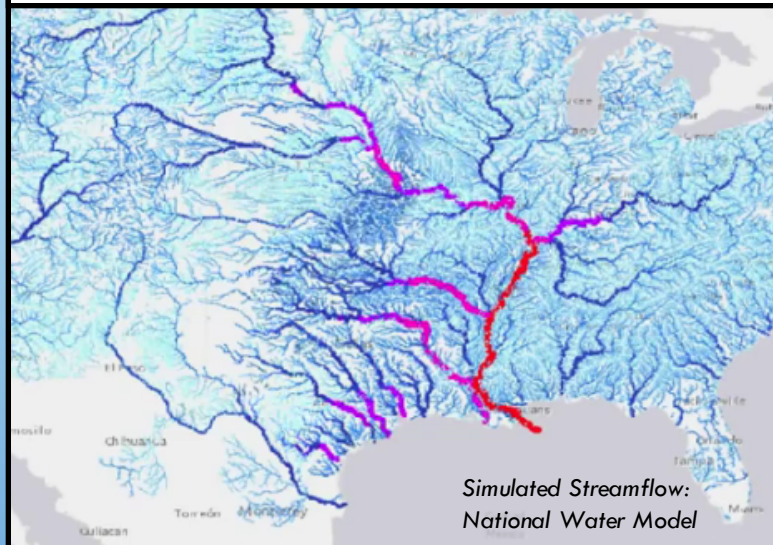
THE FUTURE ERO

FURTHER TESTING WILL TAKE PLACE DURING THE 2016 FFAIR EXPERIMENT

	Current Operational ERO	Proposed Experimental ERO
Probability	QPF Exceeding Flash Flood Guidance at a Point	Flash Flooding within 40 km of a Point (neighborhood technique)
Categorical Contours	See Text -- < 5% Slight -- 5-10% Moderate -- 10-15% High -- > 15%	Marginal -- 2% Slight -- 5% Moderate -- 10% High -- 30%
Guidance	Flash Flood Guidance	Neighborhood Probabilistic Hi-Res Ensembles (ie SSEO, HREF, HRRR) with tools including FFG and Recurrence Interval data; National Water Model
Appearance	Legacy generic contours on a white background map	Broader color contour or shading enhancement (Figure 2) similar to the SPC Convective Outlook



Probability of a flash flood within 40 km of a point



*Simulated Streamflow:
National Water Model*



Day 1 Excessive Rainfall Outlook
Valid 15Z Mon Sep 14 2015
Thru 12Z Tue Sep 15 2015
Issued: 1451Z Mon Sep 14 2015
Forecaster: OTTO
NOAA/NWS/NCEP/WPC

PROTOTYPE

Excessive Rainfall Outlook Probability Legend
2%: Marginal 10%: Moderate
5%: Slight 30%: High